U.S. AGRICULTURAL RESEARCH POLICY AND THE WORLD FOOD SITUATION 1/

Joseph W. Willett 2/

I. Present Concern About the World Food Situation

In 1972 and 1973, we saw the world food situation change quickly from economic surpluses and relatively stable prices to shortages and very high and unstable prices. This set off a wave of widespread concern about the ability of the world to feed all its people. The events in 1972 and 1973 that brought about the rapid changes have been thoroughly discussed and I will only outline them. They include a decline (only about 1.5 percent) in world food production in 1972, the first decline in at least two decades; a policy decision of the Soviet Union to import huge amounts of grain; and large U.S. grain exports and drawdown in stocks. The sharp increases in prices for grains and other commodities were contributed to by a rapid growth in demand and inflationary pressures. These events led to a decline in the quantity of food aid available for shipment to the poor countries. 3/

Although world food production increased substantially in 1975, we are still plagued by shortages of grain stocks and again the situation has been greatly affected by the crop shortfalls in the Soviet Union. Moves have been made toward resolution of the problems of further sales to the Soviet Union this year, and in later years, by recent discussions and the signing of an agreement specifying some terms of future sales. Also, following the World Food Conference in Rome in November 1974, there have been a series of international meetings, and some significant actions aimed at solutions of world food problems.

At present there is a wide range of opinion with regard to prospects for producing and distributing enough food to keep up with the growth of demand and lessen the extent of malnutrition in the world. A large part of the opinions can be classified in two groups. One group, because of their Malthusian emphasis

---

1/ Seminar presentation to faculty and students, University of Kentucky, Department of Agricultural Economics, Dec. 5, 1975.

2/ Director, Foreign Demand and Competition Division, Economic Research Service, U.S. Department of Agriculture. Mr. Willett is presently detailed to the National War College as a faculty member and Senior Research Fellow, Strategic Research Group.

3/ Economic Research Service, U.S. Department of Agriculture, Foreign Agricultural Economic Report No. 98, The World Food Situation and Prospects to 1985, Dec. 1974.

on limited resources, limited potential productivity, and unchecked population growth, is deeply pessimistic about possibilities of improvement. Another group is much more optimistic about the potential of technical improvements and better use of resources to produce enough food to improve the food situation during the next 10 to 15 years.

I think the latter group has much the better of the argument although the Malthusian view seems to have had a much greater exposure in the popular media. A view that widespread malnutrition and starvation are inevitable is not justified. A number of detailed studies by competent analysts have concluded that the world has sufficient resources and technical knowledge to feed its people adequately. These studies have been done by Iowa State University, 4/ the Food and Agriculture Organization of the United Nations (FAO), 5/ and the Economic Research Service of the U.S.

Department of Agriculture. 6/ Other studies by the University of California, 7/ the President's Science Advisory Committee 8/, and FAO's Indicative World Plan 9/ have also focused on world food prospects.

These studies agree that the world has enough basic resources to permit feeding its people adequately. They support the judgment that it is technically possible to significantly increase per capita food production in the world during the next 10 to 15 years. However, several of the studies point out that unless recent food production patterns are changed, a serious problem of increasing dependency on imported food (which they are unlikely to be willing, or perhaps even able, to pay for) by a number of the developing countries will become accentuated, and perhaps even critical. These studies agree that solutions of world food problems must include an increased emphasis on increasing crop yields in the poor countries. While there are "shortages" of land, fertilizer, water, and pesticides (as is always the case when resources cease to be free and have a market value), these can be overcome. Although higher energy and fertilizer prices are causing some increases in the cost of food production, these cost increases can be eased and perhaps overcome by technological improvements.

The World Food Conference, held in Rome in November 1974, also rejected Malthusian pessimism. The Conference proposed that "All governments should accept the removal of the scourge of hunger and malnutrition...as the objectives of the international community as a whole and accept the goal that within a decade no

4/ Blakeslee, Leroy L., Heady, Earl O., and Framingham, Charles E., World Food Production, Demand and Trade, Iowa State University Press, Ames, Iowa, 1973.

5/ United Nations, Assessment of the World Food Situation, Present and Future, Rome, 1974.

6/ Economic Research Service, op. cit.

7/ University of California Food Task Force, A Hungry World: The Challenge to Agriculture, University of California Press, Berkeley, Calif., July, 1974.

8/ President's Science Advisory Committee, The World Food Problem, Report of the Panel on the World Food Supply, The White House, Sept. 1967.

9/ Food and Agricultural Organization of the United Nations, Provisional Indicative World Plan for Agricultural Development, Aug. 1969.

child will go to bed hungry, that no family will fear for its next day's bread, and that no human being's future and capacities will be stunted by malnutrition."

I believe the problem of feeding the hungry can be solved if the political will to solve it can be mobilized. But solving these problems in a decade would be a most remarkable achievement. I stand with the optimists, but I'm not that optimistic. Maybe we could achieve this desirable goal if we had no other problems to occupy our attentions and resources. But we all know that we do have many problems, very serious ones that also clamor for solutions and which necessarily compete for attention and resources with the solution of the world food problem.

The studies listed above, the discussions and resolutions of the World Food Conference, and, I think, the near-unanimous opinions of economists, agree that the food and agricultural needs of the poor countries are unlikely to be met satisfactorily unless there is a major increase in the productivity of their agriculture--that is, in yields per acre and output per unit of input--and that this will be achieved only by a strong commitment on the part of the countries involved. There surely is a potential for large increases in productivity. For example, comparisons of the level and pattern of behavior of grain yields in the developed and developing countries support this view. Between 1948-52 and 1966-70, the group of developed countries increased their production of grain by 64 percent, with no increase in the acreage of grain. During the same period, the developing countries increased their grain production by 78 percent, but increased yields only 32 percent (one-half the rate of increase of the developed countries) while increasing their area in grains 35 percent. In 1966-70, the average grain yield in the developing countries was just about the level achieved in the developed countries 20 years earlier.

II. The World Food Conference, Proposals for National and International Action

In preparation for the World Food Conference, the Secretariat prepared two major documents; "Assessment of the World Food Situation, Present and Future," and "The World Food Problems, Proposals for National and International Action."

The latter document pointed out that until the mid-1960's, the use of modern agricultural technology in the developing countries had been confined mainly to export and industrial crops such as cocoa, tea, rubber, cotton, and oil palm. The structure of production of these crops, often on large plantations, the infrastructure for credit and markets, and the availability of foreign exchange from their export to pay for needed imports provided the basis for the relatively advanced technology used in their production. In contrast, technical progress in the production of food had generally lagged badly in the developing countries. The later successes with the new varieties of wheat and rice in those countries and those regions where the "Green Revolution" had taken place were exceptions to the rule.

Overall, modern technology has only begun to have an impact on agriculture in the developing countries. Although they have about 70 percent of the world's arable area, they use only about 25 percent of the agricultural machinery and fertilizer and about 15 percent of the pesticides. It has been estimated that only 15 percent of public expenditures on agricultural research in 1970 were

spent in the developing countries (excluding the People's Republic of China). Public research expenditures per farm in 1965 were estimated at $93 in North America, $32 in North Europe, but only $1.50 in South America, and 43 cents in South Asia. Even in relation to the value of agricultural production, research in the developing countries was greatly neglected. In 1970, expenditures on research in those countries amounted to only 0.25 percent of their gross domestic product (GDP) from agriculture, whereas in the developed countries expenditures averaged nearly 1 percent, and in Japan amounted to 2 percent. 10/

The Green Revolution was made possible by intensive research efforts over a period of years dating back to the 1940's. Rice breeding research was organized into an international center in the Phillipines in 1962. In 1968, a center for research on wheat and maize was established in Mexico. More recently, international centers have been established to work on sorghum, millets, legumes, cassava, potatoes, sweetpotatoes, beef production (in Africa and Latin America), animal diseases, and swine production. In addition, intensive study at international centers is underway on farming systems for the low humid tropics in Africa and Latin America, for semiarid regions, and for the rice-growing areas of Asia. 11/ The number of international centers for agricultural research has been increased from 4 to 8 during the past 4 years. However, needs for a regional center for the Near East and North Africa, an integrated plant nutrition center, and additional work on land development and tropical soils have been suggested. 12/ The expenditures of the international centers were less than $10 million in 1970, but they have been increasing rapidly, and it has been suggested that expenditures should be further increased substantially. In 1971, under the sponsorship of FAO, the World Bank, and the United Nations Development Program, a Consultative Group on International Agricultural Research was established. This Group, in addition to supporting international centers, finances a recently created International Plant Genetic Resources Board, which oversees a program for collecting, exchanging, storing, and evaluating world plant genetic resources.

Expenditures by the developed countries on agricultural research in or on behalf of the developing countries have been estimated at about $115 million in 1970. It has been suggested that these expenditures should rise to $200 or $250 million by 1985, but this would still represent only a small fraction of world expenditures on agricultural research. 13/ It has also been suggested that the developing countries themselves should increase their research expenditures to 0.50 percent of their GDP from agriculture, which compares with only 0.25 percent in 1970. If this were done, and if during the 15 years from 1970 to 1985 agricultural production were to grow at the 4 percent per year targeted for the U.N.'s Second Development Decade, then the research expenditures of the developing countries financed from their own budgets would rise to a level of about $900 million per year, compared with an outlay of only $250 million in 1970. This suggested increase in funds devoted to research adds up to a total of more than $1.25 billion by 1985 (at 1970 prices, this would be about 3 1/2 times the expenditure level of 1970).

10/ Food and Agricultural Organization of the United Nations, The World Food Problem, Proposals for National and International Action, Aug. 1974.

11/ Ibid.

12/ Ibid.

13/ Ibid.

III. Resolutions of the World Food Conference on Research

One of the main items on the agenda of the World Food Conference was "Measures for increasing food production in developing countries within the wider framework of development." Among the proposals for research were a survey of world land resources, a study of weather-crop relationships and of changing weather and climatic patterns, studies of the efficiency of fertilizer and pesticide use, research into the development of plant varieties which make more efficient use of nutrients and water and which are more resistent to diseases and pests, and an evaluation of rural development programs. 14/ Other areas of needed research mentioned included biological nitrogen fixation, solar and geophysical energy, alternate land use and management systems, remote sensing, and food resources from the sea and inland aquaculture. FAO was asked to undertake a systematic collection of current research, especially that relative to developing countries. A substantial enlargement of the Consultative Group on International Agricultural Research was recommended. Also recommended were demonstration programs for testing and teaching and priority on agricultural training at all levels, with special emphasis on extension work. The proposal was made that all countries should cooperate to reduce the loss of specialized technical personnel from developing countries.

IV. Activities in the United States

In his keynote address to the world food conference, Secretary of State Kissinger said: "(The United States) regards our good fortune and strength in the field of food as a global trust. We recognize the responsibilities we bear by virtue of our extraordinary productivity, our advanced technology, and our tradition of assistance....President Ford is requesting the National Academy of Sciences, in cooperation with the Department of Agriculture and other government agencies, to design a far reaching food and nutrition research program to mobilize America's talent."

The Agricultural Research Policy Advisory Committee (ARPAC) advises the U.S. Department of Agriculture and (through their National Association) the land-grant universities and colleges on planning and implementing research programs extending beyond State lines. During July 9-11, 1975, in Kansas City, ARPAC convened a National Working Conference on Research to Meet U.S. and World Food Needs. Participants in the conference included users of agricultural research results as well as administrators, researchers, members of the press, and others. The Conference developed a list of over 1,000 research problems and rated them in order of priority. After the conference, the most important 10 percent of the problems were selected, and the results have been published. An eight-man team will be selected to recommend implementation of the conference findings. This team will submit its recommendations to ARPAC in March, and ARPAC plans to act on the proposals by the following July. Dean Orville G. Bentley, of the University of Illinois, co-chairman of ARPAC, expects that the results of the Kansas City Conference will influence the direction of food research in the United States for many years to come.

In December 1974, President Ford wrote Dr. Phillip Handler, President of the National Academy of Sciences (NAS), asking that the Academy in cooperation

14/ Economic Research Service, op. cit.

with the Department of Agriculture and other Government agencies, assess the prospects for chronic world food shortages and malnutrition and "...develop and "...develop specific recommendations on how our research and development capabilities can best be applied to meet this major challenge." The President noted that "...the United States and other scientifically and technologically advanced countries have a special responsibility to turn their research capabilities toward improving the capabilities of all countries to increase their production of food and combat malnutrition and its effects."

The Academy expects to complete a long-range assessment of the research problems and submit a report to the President in June 1977. Meanwhile, the Academy has prepared an Interim Report identifying research objectives which should be reflected in agency programs as soon as possible.

The NAS Interim Report's "conclusions involve three types of action to improve the impact of U.S. research and development on world food problems, each of which reinforces the others:

(1) "...fuller participation by U.S. research institutions and scientists in international research and development systems;

(2) Strengthening of several lines of research in the U.S. that have worldwide importance as well as major importance here;

(3) ...establishment of more effective mechanisms for strategic consideration and harmonization of U.S. policies and programs concerning food and nutrition, including the research components."

At the same time that the Academy forwarded its Interim Report to President Ford, it also forwarded a report on Enhancement of Food Production for the United States, prepared by the Academy's Board on Agriculture and Renewable Resources. This report says: "Partial resolution of food and nutrition problems around the world will come from both the enhancement of production in agriculturally developing nations and the improvement of the agricultural system in the U.S. food producing capabilities.

The 1975 foreign-aid legislation contains several important new features particularly relevant to research policy. These are: (1) a new title--Tile XII (the Findley-Humphrey Amendment)--which provides funding for land-grant and other university cooperation on the agricultural research problems of developing countries; (2) amendments to the Agricultural Trade and Development Act of 1954 (P.L. 480)--Title II of the new bill--designed to channel food aid to benefit the rural poor in developing countries and to use substantial portions of the local currency proceeds from sales of P.L. 480 commodites for agricultural development projects; and (3) provision for granting $200 million to the International Fund for Agricultural Development.

Title XII provides that U.S. land-grant and "other eligible" universities should become "effectively involved" in increasing agricultural production in developing countries, in institution building to develop national and regional agricultural research capacity, in work with the international research centers, and in contract research and research program grants. Although no specific

amount is authorized, any of the funds made available under section 103 (the food nutrition category) may be used for these purposes. The 3-year limitation on length of project funding (Sec.-110b) and restrictions on other research activity (A211d) do not apply to Title XII research and development activities.

The proposed mechanism for U.S. university participation is a permanent Board for International Agricultural Development. University programs would be operated through AID and funded out of the Food and Nutrition budget. The Board will have seven members, with no less than four from the universities, with one of those representing a non-land-grant university. The Board is authorized to create a Joint Research Committee and a Joint Committee on country programs to provide assistance in carrying out Title XII programs.

The Board's duties include:

1. participating in the formulation of policy and procedure;

2. maintaining a roster of interested and eligible universities;

3. recommending countries which could benefit from Title XII programs and determining which are interested in developing institutions for teaching, research, and extension; and

4. review of terms and conditions of agreements between AID and participating universities.

V. A Research Strategy and Research Policy for the United States

What can we conclude from all this discussion of the role of agricultural research? I believe that it does represent a move in the right direction to solve the problems of feeding the hungry people of the world. Although there is still a lot of unused land in the world, an increase in productivity in food production is essential if developing countries are to keep ahead of their population growth. Scientific research is an essential step in the process, but it's not a magic wand to wave and solve all problems; it is only one of the steps necessary to rapidly improve the world food situation. Research (and development) produces new tools, but society must also develop the institutions and incentives to ensure that the tools are used effectively. Kuznets, in his Nobel Prize lecture on "Modern Economic Growth: Findings and Reflections," said that: "Advancing technology is the permissive source of economic growth, but it is only a potential, a necessary condition, in itself not sufficient.

Many studies have found that modern, rapid economic growth is heavily dependent upon rapid introduction of improved technology to increase the output per unit of input, while at the same time the inputs themselves are being increased. It is well established that this is the case for the agricultural sector as well as for the economy as a whole. Furtermore, a number of studies have shown very high social returns to agricultural research, but there is reason to be skeptical of some of these studies as being selective by examining the "gushers" rather than the "dry holes" of research. It must be admitted that there is no well-established basis for calculating the returns to agricultural research in general, since, as Kuznets points out, it is the complex combination

of research and other changes that produces the results. It is quite possible for research funds to be wasted; much depends upon how the research is used. Critics have said that U.S. funds allocated to agricultural researach programs in Latin America in the Point 4 programs during the Truman administration were not used very productively. Similar criticisms have been directed at some of the research activities of FAO.

There are many problems to be solved, and many questions to be answered before we can be reasonably confident that this new U.S. and world thrust toward agricultural research for the developing countries will be effective. Some of the important questions are: What is the best mix of international research and domestic research in the countries themselves? What is the most effective scale or size of an agricultural research institution? To what extent should research be centralized, with resources allocated and projects chosen by a central group? To what extent can be market and private enterprise be depended upon to generate technical improvements for agriculture? The Academy of Sciences' study will consider at least some of these questions.

Research and technical development alone are insufficient to solve the world food problem. It is even possible that increased agricultural productivity can make the situation worse. For many years we had surpluses of agricultural products and yet widespread hunger persisted. Hunger is largely a function of poverty and the mere production of more food may not eliminate poverty. Most of the world's food is distributed to those who have the purchasing power to buy it, and this is likely to continue to be the case. But poverty is intimately related to the development process, and very many of the poorest people are located in rural areas and dependent on agricultural work for a good part of their incomes. Food is not only something that people eat; it is also a product by which people make a living. Al Capp, the cartoonist, had a remarkable insight when he invented the Shmoo, which was the ultimate food technology. You may recall that the Shmoo, who loved everyone, and was shaped like a bowling pin, had the wonderful capacity to produce any kind of food that any consumer wanted, at any time, and in any form, and absolutely free. And yet, soon after the Shmoo appeared in any community, consternation reigned and he was soon run out of town. The reason for his unpopularity was that he put people out of work, and we know that technology can do just that.

There are real dilemmas here. It's doubtful that modern technology which will greatly increase productivity really can be labor absorbing in a broad sense in agriculture. It may be labor absorbing if new markets open up, as they might if there were no international barriers to trade. But in a limited market, because of the inelastic demand for food and because of the necessity in any new technological development to bring in new, capital-using inputs, it is doubtful that an improvement in technology will actually increase the demand for labor in agriculture as a whole. Yet technologies can be more or less labor displacing, and it is absolutely critical that in the design of technology for the poor countries every effort be made to design the kinds of technologies appropriate, not only to their natural resources of land and climate, but also to their economic resources; that is, to the combinations of high-priced capital and low-poriced labor which they actually have.

A further problem in the U.S. approach to this issue is that there are conflicts of interests involved. Little has been said about them but in the past

they have in fact been important. Neither Congress nor Administrators have been very anxious to contribute to the development of technologies for other countries for the increased production of farm products which would compete with U.S. agricultural products. Unless modified, this attitude could be a serious impediment to the effective use of U.S. research capacities in solving the food problems of the developing countries. If a country has the natural resources which give it a potential comparative advantage in production of a particular crop, research to improve its efficiency in producing that crop may have large payoffs.

Factors affecting the shortrun supply of agricultural technology are: (1) the availability of trained manpower; (2) the availability of buildings and equipment; (3) the availability of funds; (4) the availability of institutions; and (5) the availability of basic scientific knowledge. In the shortrun all the above supply factors will make the supply of technology very inelastic. In the longrun I would judge that they could all be very elastic.

Some implications of the above for U.S. policy are: (1) The solution of world food problems would be impeded if we were to hesitate to support technical research because of the possibility that increased competition will be developed for some particular U.S. agricultural commodity. (2) Because of the shortrun inelasticity of supply of agricultural technology, there is relatively little to be gained by a massive and too-rapid increase in the total funds available for all agricultural researach. If we wish to expand research quickly on the technical agricultural problems of the developing countries, we can do so only be cutting back on research on other projects of lower priority for U.S. agriculture. (3) In the longrun we can train people, build institutions, build buildings, build equipment, and expand the base of scientific knowledge. But these are long-term undertakings and it makes little sense to begin them unless commitments are to be made for a good many years ahead.

U.S. national interests in the world food problem include elements of both idealism and self-interest. There is a widespread moral judgment in the United States that our knowledge of the existence of millions of malnourished people around the world creates an ethical imperative to try to help them, even at a considerable cost to ourselves and without any direct and obvious benefits to the United States. In addition to this strictly idealistic interest, there is a widespread belief (which has for many years underlain a considerable part of our foreign aid programs) that economic development resulting in an increased and widespread economic well-being in the poor countries will contribute to social and political developments in those countries consistent with U.S. national interests. Secretary Kissinger has spoken of the "aspirations of nations and peoples for progress" as being important aspects of the international scene.

The productive strength of U.S. agriculture has made major contributions to the serving of U.S. national interests by providing relatively cheap food to consumers, by providing employment and income to farmers and agribusinessmen, and also by making important contributions to the strength of the U.S. dollar and thus U.S. ability to import and carry out costly foreign policy programs. The present comparative advantage of U.S. agriculture in a number of commodities has clearly been fostered by the socially subsidized inputs of technical agricultural research. A question to be faced now is whether or not U.S. national interests can best be served by shifting some significant part of our

technical research resources to a direct focus on increasing the agricultural productivity in the developing countries. This shift could, of course, include consideration of possible compensation to those who may be seriously injured by changes in the rules of the game because of this Government policy decision. But right now, we don't reall know whether or not there would be any serious injury done to anyone.

I suspect that overall the problems of conflict of interests are really not so difficult; that is, that the negative economic impact on parts of U.S. agriculture is not likely to be great. I suspect that the political problem will be greater the greater the degree of ignorance and the accompanying fear of the possible effects. Therefore, I think it's important that economists try to measure such effects.